CLAIMS

1. Apparatus for assaying a target analyte in a localized tissue region that may include the target and other analytes comprising:

a light source that illuminates the region with light at each of a plurality of wavelengths at which light is absorbed and/or scattered by tissue in the region wherein light at at least one of the wavelengths is absorbed or scattered by the target analyte;

a signal generator that generates signals responsive to intensity of the light from the light source at different locations in the localized region; and

a controller that:

receives the generated signals;

processes the signals to determine an extinction coefficient for light in the localized region at each wavelength; and

determines the concentration of the target analyte responsive to a solution of a set of simultaneous equations having as unknown variables concentrations of a plurality of analytes in the region, one of which is the target analyte, wherein each equation in the set expresses a relationship between the extinction coefficient, the absorption coefficient and/or the reduced scattering coefficient for light at a different one of the plurality of wavelengths and at least one of the equations expresses a relationship between the extinction coefficient and the reduced scattering coefficient.

2. Apparatus according to claim 1 wherein the at least one equation that expresses a relationship between the extinction coefficient and the reduced scattering coefficient includes a dependence on the absorption coefficient.

3. Apparatus according to claim 1 or claim 2 wherein the reduced scattering coefficient at at least one of the wavelengths is a measured value of the reduced scattering coefficient.

4. Apparatus according to any of claims 1-3 wherein the reduced scattering coefficient at least one of the wavelengths is a value determined responsive to an analytic expression.

5. Apparatus according to any of claims 1-4 wherein the reduced scattering coefficient at at least one of the wavelengths is expressed as an analytic function.

6. Apparatus according to claim 5 wherein the analytic expression is a function of at least one unknown variable having a value determinable responsive to a solution of the simultaneous equations.

7. Apparatus according to claim 6 wherein the at least one unknown variable is a concentration of at least one of the target analyte and the other analytes.

8. Apparatus according to any of claims 4-7 wherein the function comprises an expression of the form $B\lambda^{-C}$ where λ represents the wavelength and B and C are constants.

9. Apparatus according to any of the preceding claims wherein the signal generator comprises at least one acoustic transducer that generates signals responsive to acoustic energy that reaches the transducer from photoacoustic waves generated in the region by the light.

10. Apparatus according to any of the preceding claims wherein the signal generator comprises an optical coherence tomography device that receives light from the light source that is scattered from the region and generates an interference signal responsive to an interference pattern between the scattered light and light from the light source reflected by a reflector.

11. Apparatus according to any of the preceding claims wherein the controller identifies and locates the localized region in a larger region comprising the localized region.

12. Apparatus according to claim 11 wherein to identify and locate the localized region the controller:

controls the light source to illuminate the larger region with light that is absorbed by a component characteristic of the localized region;

receives signals generated by the signal generator responsive to intensity of the light from the light source in different locations in the larger region;

uses the signals to assay the characteristic component in different localized regions in the larger region; and

identifies and locates the localized region responsive to the assay.

13. Apparatus according to claim 11 or claim 12 wherein the apparatus comprises at least one acoustic transducer controllable to transmit ultrasound, and to identify and locate the localized region the controller:

controls the at least one transducer to transmit ultrasound into the larger region;

receives signals generated by the at least one acoustic transducer responsive to acoustic energy reflected by features in the larger region from the transmitted ultrasound; and

uses the signals to identify and locate the features and thereby the localized region.

14. Apparatus according to any of the preceding claims wherein the localized region is a bolus of blood.

15. A method of assaying a target analyte in a region of body tissue that may include the target and other analytes comprising:

determining an extinction coefficient for light at each of a plurality of different wavelengths at which light is absorbed and/or scattered by tissue in the region and wherein light at at least one of the wavelengths is absorbed and/or scattered by the analyte;

providing a value or an analytic expression for the reduced scattering coefficient at each wavelength; and

determining the concentration of the target analyte responsive to a solution of a set of simultaneous equations having as unknown variables concentrations of a plurality of analytes in the region, one of which is the target analyte, wherein each equation in the set expresses a relationship between the extinction coefficient, the absorption coefficient and/or the reduced scattering coefficient for light at a different one of the plurality of wavelengths and at least one of the equations expresses a relationship between the extinction coefficient and the reduced scattering coefficient.

16. A method according to claim 15 wherein the at least one equation that expresses a relationship between the extinction coefficient and the reduced scattering coefficient includes a dependence on the absorption coefficient.

17. A method according to claim 15 or claim 16 wherein determining the extinction coefficient at at least one of the wavelengths of the plurality of wavelengths comprises:

from a given location illuminating the region with light at the wavelength so as to generate photoacoustic waves in the region;

determining a rate of decrease amplitude of the generated photoacoustic waves with increase of distance in the tissue region from the given location; and

determining the extinction coefficient from the determined rate of decrease.

18. A method according to any of claims 15-17 wherein determining the extinction coefficient at at least one of the wavelengths of the plurality of wavelengths comprises:

from a given location illuminating the region with light at the wavelength;

using optical coherence tomography to determine a rate of decrease of intensity of the light with increase of distance in the tissue region from the given location; and

determining the extinction coefficient from the determined rate of decrease.

19. A method according to any of claims 15-18 wherein the reduced scattering coefficient at at least one of the wavelengths is a measured value of the reduced scattering coefficient.

20. A method according to any of claims 15-19 wherein the reduced scattering coefficient at least one of the wavelengths is a value determined responsive to an analytic expression.

21. A method according to any of claims 15-20 wherein and comprising expressing the reduced scattering coefficient in at least one of the equations as an analytic function.

22. A method according to claim 21 wherein the analytic expression is a function of at least one unknown variable having a value determinable responsive to a solution of the simultaneous equations.

23. A method according to claim 22 wherein the at least one unknown variable is a concentration of at least one of the target analyte and other analytes.

24. A method according to any of claims 20-23 wherein the analytic expression comprises an expression of the form $B\lambda^{-C}$ where λ represents the wavelength and B and C are constants.

25. A method according to any of claims 15-24 and comprising identifying and locating the localized region in a larger region comprising the localized region.

26. A method according to claim 25 wherein identifying and locating the localized region comprises:

illuminating the larger region with light that is absorbed by a component characteristic of the localized region;

generating signals responsive to intensity of the light at different locations in the larger region;

using the signals to assay the characteristic component in different localized regions in the larger region; and

identifying and locating the localized region responsive to the assay.

27. A method according to claim 25 or claim 26 wherein identifying and locating the localized region comprises:

transmitting ultrasound into the larger region;

generating signals responsive to acoustic energy reflected by features in the larger region from the transmitted ultrasound; and

using the signals to identify and locate the features;

using the identities and locations of the features to identify and locate the localized region.

28. A method according to any of the preceding claims wherein the localized region is a bolus of blood.